Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

MINOR NOTICES

Lodgepole burn forests.—The Forest Service has recently issued a bulletin which should be of great interest to all ecologists. Dr. F. E. CLEMENTS,[3] working as collaborator, has made a study of the forests of lodgepole pine in the vicinity of Long's Peak, Colorado. He finds that the lodgepole forests in that region are invariably related to forest fires, since the tree reproduces abundantly only under the conditions initiated by such events.

By a determination of the ages of the oldest plants, principally lodgepoles, which have come into the given locality since the fire, and by study of fire scars upon the trunks, he sets the date of the fire and determines the extent of country affected by it. In this way he has discovered the dates and determined the extents of many fires of the past two centuries, with considerable accuracy in the case of the recent ones, with less accuracy in the case of the less recent. Eight fires were found to have affected the region during the nineteenth century, and the areas covered by several of them overlap. There were four fires during the eighteenth century and a probable one in 1676. The accuracy with which the dates may be determined is due to the fact that abundant reproduction of lodgepole occurs the first year after the fire, and the majority of the trees are therefore even-aged to the year.

A study of the life history of the species follows, in which is found the explanation of the particular type of forest which the lodgepole pine produces. Immediate and abundant reproduction is favored by fire because (1) it causes the opening of many cones at once without damaging the seed; (2) it brings about the temporary disappearance of rodents, which ordinarily consume immense quantities of seed; (3) abundant light is provided, a necessity for reproduction and growth in this species; (4) cover competition is destroyed.

Finally, the future development and treatment of lodgepole forests are discussed. If fire is kept out, the lodgepole forest zone will be gradually narrowed and ultimately crowded out of existence by encroachment of Douglas fir from below and of Engelmann spruce and subalpine fir from above, owing to the much greater tolerance of shade which these species possess. In order to produce a new crop of lodgepole, clear cutting of the forest will be necessary, followed by thorough burning. Mere cutting without fire does not produce the requisite conditions.—WILLIAM S. COOPER.

NOTES FOR STUDENTS

Alcoholic fermentation.—Important contributions to our knowledge of the fermentation of sugar have been made by HARDEN and YOUNG, and by IWANOFF, in their experiments on the action of phosphates in alcoholic fermentation. Although these investigators agree in the main, their views differ as to the details of the reactions involved in the fermentation of sugar in the presence of phosphates. For a clearer understanding of a number of recent papers on the subject by these writers, their views may be outlined briefly here.

---

[3] CLEMENTS, F. E., The life history of lodgepole burn forests. U.S. Dept. Agri., Forest Service Bulletin 79. pp. 56. *pls. 6. fig. 1.* 1909.

The view of HARDEN and YOUNG, as expressed in a number of former papers, on the manner in which the addition of phosphates to a fermenting mixture of yeast juice and sugar causes an increased evolution of carbon dioxid, is derived from the following observations. When phosphates are added to a fermenting mixture of glucose and yeast juice, the amount of carbon dioxid evolved from the fermenting mixture is greatly increased. The extra carbon dioxid is all given off during an initial period of accelerated fermentation, after which the rate of evolution decreases and continues at a uniform rate. During the initial period of fermentation, the phosphates enter into combination with the sugar in a form not precipitable by ammoniacal magnesium citrate. During the second or uniform period of fermentation, the phosphates are again set free. The carbon dioxid given off during the initial period is chemically equivalent to the amount of phosphate added. These facts are formulated in the following equations.

I. $2C_6H_{12}O_6+2R_2HPO_4=2CO_2+2C_2H_6O+2H_2O+C_6H_{10}O_4(PO_4R_2)_2$

II. $C_6H_{10}O_4(PO_4R_2)_2+2H_2O=C_6H_{12}O_6+2R_2HPO_4$

According to this view, the phosphate combines with the sugar to form a hexose-phosphate. This reaction gives the extra carbon dioxid evolved during the initial period after the addition of a phosphate, while the rate of the second reaction determines the steady rate of fermentation at which the simple sugars are fermented by yeast juice without the addition of phosphates.

The view of IWANOFF differs from the foregoing chiefly in the following details. The phospho-organic compound formed in a mixture of sugar, zymin, or "Hefanol" and a phosphate is a triose-phosphate and not a hexose-phosphate. The formation of the triose-phosphate is not necessarily accompanied by the evolution of carbon dioxid, because the combination takes place also when a phosphate is added to the filtrate of a sugar solution which has been fermented by zymin. Therefore, the combination may take place without the accompaniment of fermentation or the evolution of carbon dioxid.

Further evidence in support of his interpretation is given by IWANOFF in a recent paper.[4] The main facts and conclusions of this paper may be stated briefly, without going into the experiments upon which they are based. It is found that the filtrate of a mixture of zymin and saccharose in water fermented one day is capable of combining with phosphates, but that this power of combination is lost when the filtrate is heated. The sugar which can be in part liberated from the phospho-organic compound is not fermentable by living yeast. Further, "Hefanol" washed with water will ferment the phospho-organic compound (triose-phosphate of the author), but not glucose, even after the addition of phosphate.

---

[4] IWANOFF, S., Ueber die Bildung der phosphororganischen Verbindungen und ihre Rolle bei der Zymasegärung. Centralbl. Bakt. II. **24**:1–12. 1909.

From these facts the following conclusions are drawn. First, the combination of sugar and phosphates is effected by a soluble enzyme to which the author gives the name "synthease." Second, if the phospho-organic compound were a hexose-compound, as maintained by HARDEN and YOUNG, fermentation by living yeast should take place after the sugar, a hexose in this case, has been liberated from the phosphate. Since such fermentation does not take place, the sugar liberated must be a triose. Third, since "Hefanol," which by washing has been freed from "synthease," will ferment triose-phosphate but not glucose, the synthesis of the triose-phosphate is a necessary intermediate step in the fermentation of sugar.

The author represents his view of the course of fermentation in three stages: (1) depolymerization of glucose, (2) synthesis of triose-phosphate by the soluble enzyme "synthease," and (3) splitting of the triose-phosphate by "alcoholase," an almost insoluble enzyme remaining in the zymin residue after washing.

In a later paper,[5] somewhat controversial in its nature, HARDEN and YOUNG present the results of further studies bearing directly on IWANOFF'S contentions. They point out that if IWANOFF'S formulation of the process of fermentation is correct, the triose-phosphate of IWANOFF is an intermediate compound, the formation of which *precedes* the evolution of carbon dioxid; whereas the authors have shown that the formation of the phospho-organic compound is *accompanied* by the evolution of carbon dioxid. The case is the same whether yeast juice or zymin is used. It is further shown that the filtrate from a fermenting mixture of cane sugar and zymin, prepared after the method of IWANOFF, is still capable of producing fermentation; therefore the formation of the phospho-organic compound taking place when phosphates are added to such filtrate, is not proof that the phospho-organic compound can be formed without the accompaniment of fermentation. With regard to IWANOFF'S "synthease," the authors show that the process of washing zymin employed by IWANOFF removes the soluble coenzyme of yeast juice, without which fermentation does not take place. When the boiled washings are added to the residue, the power to ferment glucose is restored. The loss of fermenting power of washed zymin is explained, therefore, by the removal of a soluble thermostable coenzyme. Since the boiled washings, if added to the residue, restore its power of fermentation, the authors contend that the reactivating power is not due to IWANOFF'S "synthease," which therefore has no existence.

Other experiments bearing on this subject have been reported in another paper by HARDEN and YOUNG.[6] Several phases of the question are taken up individually. The first series of experiments relating to the ratio of carbon dioxid to sugar fermented in the presence of excess of phosphates shows that the ratio agrees with that derived from the reaction formula given by the authors, that is, $2C_6H_{12}O_6 \rightarrow 2CO_2$, for the period of accelerated fermentation that follows the addition of phosphates to a fermenting mixture.

---

[5] HARDEN, A., and YOUNG, W. J., The function of phosphates in alcoholic fermentation. Centralbl. Bakt. II. **26**:178–184. 1910.

[6] ——— The alcoholic ferment of yeast juice. Proc. Roy. Soc. B **82**:321–330. 1910.

The question as to the necessity of phosphates for alcoholic fermentation is also taken up. While it has never been conclusively shown that alcoholic fermentation cannot take place in the absence of phosphates, the experiments here given furnish strong evidence in favor of the view that phosphates are necessary for alcoholic fermentation. The authors reduced the quantity of phosphates in fermenting mixtures to a minimum, and found that the addition of very small quantities of phosphates to such mixtures increased the evolution of carbon dioxid as much as 700 per cent of the original amount; while if no precaution is taken to remove the phosphates from the mixture at first, further addition of phosphates gives an increase of only 10–150 per cent of the original. The relatively large increase in fermentation due to the addition of small quantities of phosphates is regarded as strong evidence that phosphates are necessary in fermentation.

It is further shown that the hexose-phosphate when hydrolyzed by the enzymes of yeast juice yields a sugar which is fermented by living yeast, a result which is opposed to the conclusion of IWANOFF mentioned above. The sugar thus obtained gives the reactions of fructose, although the possibility that other hexoses may be present is not excluded.

Putting the facts thus far gained into the shape of a tentative theory, HARDEN and YOUNG suggest that two molecules of hexose may be decomposed into smaller groups, two of which go to form alcohol and carbon dioxid. The other two residues are synthesized into a new chain of six carbon atoms, which forms the carbohydrate part of the hexose-phosphate.

Papers taking up the question of fermentation from a different viewpoint have been published by KOHL and by KUSSEROW. KOHL'S[7] work relates chiefly to the part played by the enzymes in the different steps of fermentation. As far as the steps by which sugar is transformed into alcohol are concerned, he adheres to the original view of BUCHNER that lactic acid is an intermediate product. BUCHNER attributes the first step in this process to the action of an enzyme which he called zymase, and which is not easily extracted from the cells by the usual solvents for enzymes. KOHL finds that none of the enzymes extracted from yeast by glycerin or water are capable of transforming lactic acid into alcohol and carbon dioxid. It is therefore this step, he reasons, and not the changing of sugar into lactic acid, which must be attributed to the action of zymase. This leaves the splitting of lactic acid into alcohol and carbon dioxid to be accomplished by some of the soluble enzymes of the yeast extract. It is here that the author finds a function for catalase. The extract is rich in catalase, and since no other function for this enzyme is known, he makes it the active agent in the first step of fermentation according to the scheme. Nor is this view reached without apparent experimental evidence. Extracts of yeast rich in catalase were allowed to act for various lengths of time on 10 per cent glucose solutions. The solutions were found to contain lactic acid, which was identified by its zinc and calcium salts and by other tests. Unfortunately the experiments are not entirely convincing, since the only precaution to insure sterility was the addition of thymol to the flasks. It is not recorded that cultures were made from the flasks at the end of the experiments to demonstrate their sterility. The finding of oxalic acid in the flasks would seem to add to the doubtfulness of the experiments.

---

[7] KOHL, F. G., Ueber das Wesen der Alkoholgärung. Beih. Bot. Centralbl. I. **25**:115–126. 1910.

KUSSEROW,[8] believing that no description of the mechanism of fermentation has been given, propounds a new theory of alcoholic fermentation. This theory is that the demand of the yeast cell for oxygen results in the reduction of glucose to sorbite, a molecule of water being involved in the reaction. The sorbite breaks up directly into alcohol, carbon dioxid, and hydrogen. The hydrogen reduces a further molecule of glucose, and so the process goes on. The view is scarcely supported by evidence, nor would the dearth of theories alone seem to warrant it, for several have been proposed.—H. HASSELBRING.

Vegetative reproduction in Metzgeria.—EVANS[9] has described the gemmae of 12 species of *Metzgeria*. They fall into three groups, depending upon their position on the thallus. The first group (5 spp.) has the gemmae marginal; the second (6 spp.) has them on the antical surface of the wings; and in the third group (1 sp.) they are indefinite in position. When a gemma is to be produced, a marginal cell projects beyond its neighbors and its outer wall is ruptured. The protruding protoplast is not naked, however, but is covered by a thick layer of transparent gelatinous substance, which EVANS thinks is a modification of the inner portion of the original wall. Upon the inner surface of this gelatinous substance a very thin new wall soon appears. The projecting cell divides by a periclinal wall; the outer of these two cells is considered to be the mother cell of the gemma. A second wall meets the first, obliquely cutting off a wedge-shaped apical cell, which proceeds to cut off segments right and left. The original gelatinous substance becomes stretched by the growth of the gemma until it finally disappears. The gemma is separated from the plant by the splitting of the original periclinal wall. Along the margin of the young gemma hooked hairs appear. As it becomes older, new hairs appear, which function as rhizoids. The young gemma shows no sign of dorsiventrality.

---

[8] KUSSEROW, R., Centralbl. Bakt. II. **26**:184–187. 1910.

[9] EVANS, ALEXANDER W., Vegetative reproduction in *Metzgeria*. Annals of Botany **24**:272–303. *figs. 16*. 1910.